

Notice No.3

Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk, July 2021

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Please note that corrigenda amends to paragraphs, Tables and Figures are not shown in their entirety.

Issue date: June 2022

Amendments to	Effective date	IACS/IMO implementation (if applicable)
LR IV	1 July 2022	N/A
Chapter 4, Section 4.21	1 July 2022	N/A
Chapter 6, Section 6.3	1 July 2022	1 July 2022
Chapter 11, Section 11.3	1 July 2022	Corrigendum



LR IV

Information and Plans

LR IV.1 Required Information and Plans

(Part only shown)

LR IV.1 In addition to the plans required by the Rules for Ships, the following information and plans are to be submitted, where applicable:

The following plans and particulars for type A independent tanks are to be submitted for approval before construction is commenced:

- Details and procedures of the hydropneumatic or hydrostatic test.
- Supporting calculations to demonstrate that the tank test condition complies with 4.21.5.

The following plans and particulars for type B independent tanks primarily constructed of plane surfaces are to be submitted for approval before construction is commenced:

- Details and procedures of the hydropneumatic or hydrostatic test.
- Supporting calculations to demonstrate that the tank test condition complies with 4.22.6.

The following plans and particulars for Type C independent tanks are to be submitted for approval before construction is commenced:

Chapter 4

Cargo Containment

Part E – Tank Types

4.21.2 Structural analysis

(Part only shown)

LR 4.21-03 The scantlings of the cargo tanks are to comply with the requirements of LR 4.21-04 and the following:

(g) Internal bulkheads (Non-perforated).

- (i) Where a bulkhead may be subjected to an internal pressure head, P_{eq} , resulting from loading on one side only, the scantlings of plating, and stiffeners are to be determined from (b) and (c), see also (k)(i).
- (ii) Where no such loading condition is envisaged, and where the arrangement of the centreline bulkhead in way of the tank dome creates a common vapour space between the port and starboard sides of the tank, the scantlings may be derived as follows:

The thickness of plating and the section modulus of stiffeners are to be derived from (b) and (c) respectively, but P_{eq} (in MPa) need not exceed the greater of:

$$\frac{h_p}{1.02 \times 10^5} \text{ or}$$

$$P_{HP} - P_{air} \text{ or}$$

$$\frac{h_p p}{1.02 \times 10^5}$$

$$\text{or } \frac{a_{yy} b_{st} \rho}{1.02 \times 10^5}$$

where

P_{HP} = tank testing load, see LR 4.21.05

P_{air} = air test pressure, see LR 4.21.05

b_{st} = maximum breadth from centreline bulkhead to tank side

a_y = maximum dimensionless accelerations in transverse direction, see 4.28.2.

In such instances, due consideration is to be given to the tank testing procedures and the loading manual. Loading Manual is to include the following note:

‘Centreline bulkhead scantlings of cargo tanks are approved for symmetrical filling levels either side of the centreline bulkhead in sea-going conditions.’

4.21.5 Testing

All type A independent tanks shall be subjected to a hydrostatic or hydropneumatic test. This test shall be performed such that the stresses approximate, as far as practicable, the design stresses, and that the pressure at the top of the tank corresponds at least to the MARVS. When a hydropneumatic test is performed, the conditions shall simulate, as far as practicable, the design loading of the tank and of its support structure, including dynamic components, while avoiding stress levels that could cause permanent deformation.

~~LR 4.21-05~~ If a hydropneumatic test is utilised, the head of water, h_{HP} , required to model the design pressure, P_{eq} , is to be taken as:

$$h_{HP} = \frac{102 (P_{eq} - P_{air})}{\rho_r} + y$$

where

h_{HP} = hydropneumatic test head of water, in metres, measured from bottom of cargo tank

P_{eq} = design pressure, in MPa, at location under consideration as derived from 4.28.1.1

P_{air} = air test pressure, in MPa

ρ_r = relative density

= ρ/ρ_{fw}

ρ = density of test fluid

ρ_{fw} = density of freshwater to be taken as 1000 kg/m³ at 4°C

y = the vertical distance, in metres, from bottom of tank to the location under consideration, see Fig. LR 4.2

For a given head of water, the load P_{HP} , in MPa, at the location under consideration would be:

$$P_{HP} = P_{air} + (h_{HP} - y) \frac{\rho_r}{102}$$

Care is to be given that the ratio

$$\frac{P_{HP}}{P_{eq}} \leq 1,0 \quad \text{at any point around the tank.}$$

~~LR 4.21-06~~ If a hydrostatic test is utilised, the head of water, h_{HS} , required to model the design pressure, P_{eq} , is to be taken as:

$$h_{HS} = \frac{102 P_{eq}}{\rho_r} (h - y)$$

where

h_{HS} = hydrostatic test head of water, in metres, measured above top of cargo tank of depth h

h = height of tank, in metres, see Fig. LR 4.2.

For a given head of water, the load P_{HS} , in MPa, at the location under consideration would be:

$$P_{HS} = (h_{HS} + (h - y)) \frac{\rho_r}{102}$$

Care is to be given that the ratio

$$\frac{P_{HS}}{P_{eq}} \leq 1,0 \quad \text{at any point around the tank.}$$

~~LR 4.21-07~~ The test pressure is to be not less than the MARVS and is not normally to exceed the relief valve harbour setting:

$$P_{max} = \left(\frac{t_{min} - 1}{0,04 \text{ s } f \sqrt{k}} \right)^2 \text{ MPa}$$

The design pressure is not to be exceeded at any point, and the test should adequately load all areas of the tank. See also Pt 3, Ch 1, 8.3.6 in the Rules for Ships. When testing takes place after installation of the tanks on board ship, care is to be taken that the test head does not result in excessive local loading on the hull structure. For this purpose, when the cargo tanks are centrally divided with a non-perforated bulkhead, consideration will be given to testing the port and starboard sides of the tank independently.

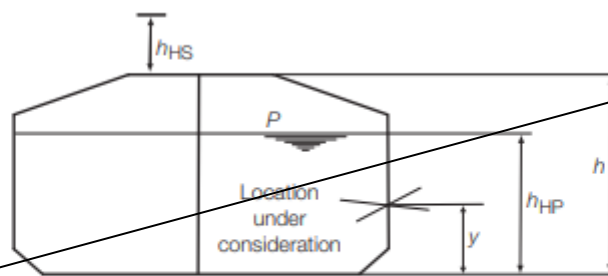


Fig. LR 4.2 Test head(s)

Existing paragraphs LR 4.21-05 to LR 4.21-07 have been deleted and replaced with below:

LR 4.21-05 If a hydropneumatic or a hydrostatic test is utilised, the test head of water and air pressure are to be specified by designers. Details and procedures of the hydropneumatic or hydrostatic test are to be submitted for approval.

LR 4.21-06 The scantlings of the tanks are to comply with LR 4.21-03, using equivalent internal pressure for the test condition.

LR 4.21-07 The primary structures of the tanks are to comply with Ch 2, 4.7 Tank test condition of the ShipRight Structural Design Assessment Procedure for Type A Tank Liquefied Gas Carriers and Ch 2, 4.7 Tank test condition of the ShipRight Structural Design Assessment Primary Hull and Cargo Tank Structure of Liquefied Gas Carriers Fitted with Type B Independent Tanks Primarily Constructed of Plane Surfaces for type A tanks and type B tanks primarily constructed of plane surfaces respectively.

Chapter 6

Materials of Construction and Quality Control

6.3 General test requirements and specifications

6.3.2 Toughness test

LR 6.3-02 Material toughness is to be determined by the Charpy V-notch impact test in accordance with the Rules for Materials [Rules for the Manufacture, Testing and Certification of Materials](#). In addition, LR may also request other types of tests, such as drop weight or crack tip opening displacement test. When required by Ch 3, 6.1 Scope 6.1.4 of the [Rules for the Manufacture, Testing and Certification of Materials](#), an additional set of Charpy V-notch specimens with axes located on the centreline of thickness of the plate is required.

6.4 Requirements for metallic materials

6.4.1 General requirements for metallic materials

(Part only shown)

6.4.1.1 The requirements for materials of construction are shown in the tables as follows:

(Part only shown)

Table LR 6.1

PLATES, PIPES (SEAMLESS AND WELDED) See notes 1 and 2 , SECTIONS AND FORGINGS FOR CARGO TANKS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES NOT LOWER THAN 0°C		
Test temperature	Thickness t (mm)	Test temperature (°C)
	$t \leq 20$	0 (See LR 4)
	$20 < t \leq 40$ See note 3	-20

Notes

1 For seamless pipes and fittings normal practice applies. The use of longitudinally and spirally welded pipes shall be specially approved by the Administration or recognized organization acting on its behalf. (See LR 1).

3 This table is generally applicable for material thicknesses up to 40 mm. Proposals for greater thicknesses shall be approved by the Administration or recognized organization acting on its behalf. (See LR 7).

5 Materials with specified minimum yield stress exceeding 410 N/mm² may be approved by the Administration or recognized organization acting on its behalf. For these materials, particular attention shall be given to the hardness of the welded and heat affected zones. (See LR 3).

LR 1 Welded pressure pipes complying with the requirements of Chapter 6 of the Rules for Materials are acceptable, and special approval is not required. (See LR 3).

LR 7 For plate of thickness greater than 40 mm and up to 50 mm for a design temperature not lower than 0°C, the impact tests are to be conducted in accordance with Table LR 6.1.1.

Table LR 6.1.1

Test temperature	Thickness t (mm)	Test temperature (°C)
	$40 < t \leq 50$	-20 (see LR 7a)
	$40 < t \leq 50$	-30 (see LR 7b)

LR 7a: Applies to Type C independent tanks and process pressure vessels. In addition, post-weld heat treatment shall be performed. Proposals for exemption of post-weld heat treatment based on an alternative approach (e.g. Engineering Critical Assessment in accordance with BS7910 or an equivalent standard) shall be approved by LR.

LR7b: Applies to cargo tank other than Type C.

(Part only shown)

Table LR 6.2

PLATES, SECTIONS AND FORGINGS^{See note 1} FOR CARGO TANKS, SECONDARY BARRIERS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES BELOW 0°C AND DOWN TO -55°C Maximum thickness 25 mm^{See note 2}

Notes

1 The Charpy V-notch and chemistry requirements for forgings may be specially considered by the Administration.

2 For material thickness of more than 25 mm, Charpy V-notch tests shall be conducted as follows:

Material thickness t (mm)	Test temperature (°C)
$25 < t \leq 30$	10°C below design temperature or -20°C, whichever is lower
$30 < t \leq 35$	15°C below design temperature or -20°C, whichever is lower
$35 < t \leq 40$	20°C below design temperature
$40 < t$	Temperature approved by the Administration or recognized organization acting on its behalf (see LR 1)

~~LR 1 The temperature requirement is subject to agreement with LR.~~

The impact energy value shall be in accordance with the table for the applicable type of test specimen.

Materials for tanks and parts of tanks which are completely thermally stress relieved after welding may be tested at a temperature 5°C below design temperature or -20°C, whichever is lower.

For thermally stress relieved reinforcements and other fittings, the test temperature shall be the same as that required for the adjacent tank-shell thickness. (See LR 1a)

LR 1 For plates of thickness greater than 40 mm and up to 50 mm for a design temperature lower than 0°C and down to -55°C, the impact tests are to be conducted in accordance with Table LR 6.2.1:

Table LR 6.2.1

Test temperature	Thickness t (mm)	Test temperature (°C)
	$40 < t \leq 50$	5°C below design temperature or -20°C, whichever is lower (see LR 1a)
	$40 < t \leq 50$	25°C below design temperature (see LR 1b)
	$45 < t \leq 50$	30°C below design temperature (see LR 1b)
LR 1a: Applies to Type C independent tanks and process pressure vessels. Post-weld heat treatment shall be performed. Proposals for exemption of post-weld heat treatment based on an alternative approach (e.g. Engineering Critical Assessment in accordance with BS7910 or an equivalent standard) shall be approved by LR. LR 1b: Applies to cargo tank other than Type C.		

(Part only shown)

Table LR 6.3

PLATES, SECTIONS AND FORGINGS^{See note 1} **FOR CARGO TANKS, SECONDARY BARRIERS AND PROCESS PRESSURE VESSELS FOR DESIGN TEMPERATURES BELOW -55°C AND DOWN TO -165°C**^{See note 2} **Maximum thickness 25 mm**^{See notes 3 and 4}

Notes

3 For materials 1.5% Ni, 2.25% Ni, 3.5% Ni and 5% Ni, with thicknesses greater than 25 mm, the impact tests shall be conducted as follows:

Material thickness t (mm)	Test temperature (°C)
$25 < t \leq 30$	10°C below design temperature
$30 < t \leq 35$	15°C below design temperature
$35 < t \leq 40$	20°C below design temperature

The energy value shall be in accordance with the table for the applicable type of test specimen. For material thickness of more than 40 mm the Charpy V-notch values shall be specially considered (see **LR 1**).

LR 1 In no case should the test temperature exceed that shown in the main table above. For materials 1,5% Ni, 2,25% Ni, 3,5% Ni and 5% Ni, with thicknesses greater than 40 mm and up to 50 mm, the impact tests are to be conducted in accordance with **Table LR 6.3.1**.

Table LR 6.3.1

Material thickness t (mm)	Test temperature (°C)
$40 < t \leq 45$	25°C below design temperature
$45 < t \leq 50$	30°C below design temperature

In no case should the test temperature exceed that shown in the main table above.

(Part only shown)

Table LR 6.4

PIPES (SEAMLESS AND WELDED) ^{See note 1} , FORGINGS ^{See note 2} AND CASTINGS ^{See note 2} FOR CARGO AND PROCESS PIPING FOR DESIGN TEMPERATURES BELOW 0°C AND DOWN TO -165°C ^{See note 3} Maximum thickness 25 mm			
Minimum design temperature (°C)	Chemical composition ^{See note 5} and heat treatment	Impact test	
		Test temp. (°C)	Minimum average energy (KV)
-55	Carbon-manganese steel. Fully killed fine grain. Normalized or as agreed ^{See note 6}	See note 4	27
-65	2.25% nickel steel. Normalized, normalized and tempered or quenched and tempered ^{See notes 6 and 7}	-70	34

6.6 Other requirements for construction in metallic materials

6.6.2 Independent tank

LR 6.6-01 Manufacture and workmanship are to satisfy the requirements of [Rules for the Manufacture, Testing and Certification of Materials, Ch 13, 4 Specific requirements for fusion welded pressure vessels](#) [Ch 13, 4 Specific requirements for fusion welded pressure vessels](#) in the [Rules for the Manufacture, Testing and Certification of Materials](#).

LR 6.6-02 For type C independent tanks other than the above, the post-weld heat treatment is to conform to the requirements of the [Rules for the Manufacture, Testing and Certification of Materials, Ch 13, 4.10 Post-weld heat treatment](#) and [Ch 13, 4.11 Basic requirements for post-weld heat treatment of fusion welded pressure vessels](#). For all carbon and carbon-manganese steel tanks requiring heat treatment, the requirements of [Rules for the Manufacture, Testing and Certification of Materials, Ch 13, 4.10 Post-weld heat treatment](#), [Table 13.4.2 Post-weld heat treatment requirements](#) are to be complied with.

For Type C tanks of carbon and carbon-manganese steel with plate thickness up to 40 mm, post-weld heat treatment shall be performed after welding, if the design temperature is equal to or less than -10°C.

For Type C independent tanks with plate thickness up to 40 mm, if the design temperature is higher than -10°C, and for any other carbon and carbon-manganese tanks, the post-weld heat treatment is to conform to the requirements of [Ch 13, 4.10 Post-weld heat treatment](#) in the [Rules for the Manufacture, Testing and Certification of Materials](#).

For Type C tanks of carbon and carbon-manganese steel with plate thickness greater than 40 mm and up to 50 mm, post-weld heat treatment shall be performed after welding. Any proposal for exemption of post-weld heat treatment is to be based on an alternative approach as approved by LR (e.g. Engineering Critical Assessment in accordance with BS7910 or an equivalent standard). Mechanical stress relieving as permitted under [Ch 6, 6.6 Other requirements for construction in metallic materials 6.6.2.3](#) is not applicable for Type C tanks of carbon and carbon-manganese steel with plate thickness greater than 40 mm and up to 50 mm.

The requirements of [Ch 13, 1.16 Post-weld heat treatment](#) and [Ch 13, 4.11 Basic requirements for post-weld heat treatment of fusion welded pressure vessels](#) in the [Rules for the Manufacture, Testing and Certification of Materials](#) are to be followed for the method and technique of post-weld heat treatment.

Chapter 11 Fire Protection and Extinction

11.3 Water-spray system

LR 11.3-02 Where 'F.O. tanks' are installed at the after end of the aftermost hold space or at the forward end of the forwardmost hold space instead of cofferdams as allowed for in paragraphs 3.1.2 and 3.1.3 of the IGC Code, the weather deck area above these tanks shall be regarded as a 'cargo area' for the purpose of applying paragraph 11.3.6 of the IGC Code.

© Lloyd's Register Group Limited 2022
Published by Lloyd's Register Group Limited
Registered office (Reg. no. 08126909)
71 Fenchurch Street, London, EC3M 4BS
United Kingdom

Lloyd's Register and variants of it are trading names of Lloyd's Register Group Limited, its subsidiaries and affiliates. For further details please see <http://www.lr.org/entities>

Lloyd's Register Group Limited, its subsidiaries and affiliates and their respective officers, employees or agents are, individually and collectively, referred to in this clause as 'Lloyd's Register'. Lloyd's Register assumes no responsibility and shall not be liable to any person for any loss, damage or expense caused by reliance on the information or advice in this document or howsoever provided, unless that person has signed a contract with the relevant Lloyd's Register entity for the provision of this information or advice and in that case any responsibility or liability is exclusively on the terms and conditions set out in that contract.